

**RIVER
DESIGN
GROUP, INC.**

10908 Hwy 93 South
Whitefish, MT 59927
Tel: 406/862-4923
Fax: 406/862-4962

311 SW Jefferson Avenue
Covellville, OR 97333
Tel: 541/291-2920
Fax: 541/291-2924



WestWater Consultants, Inc.



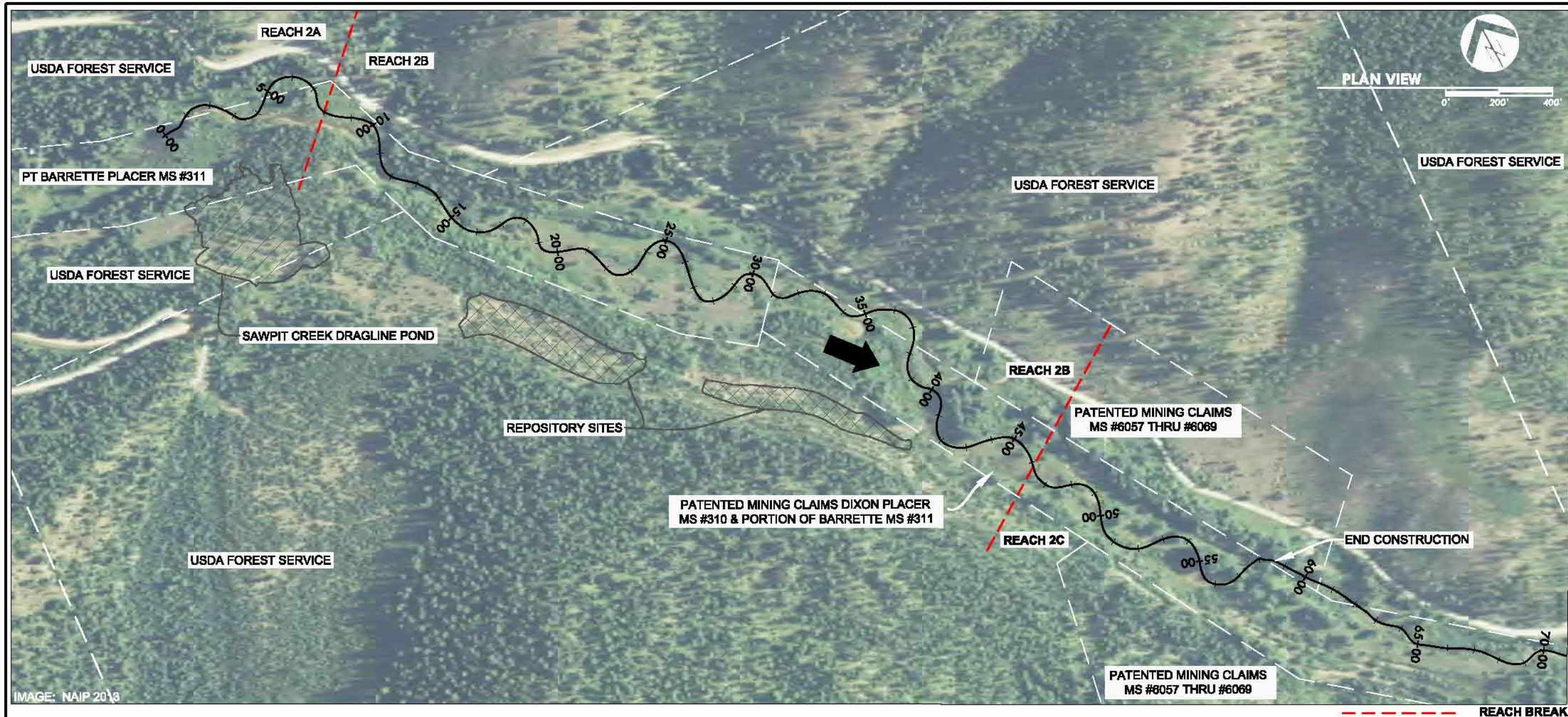
Geum
Environmental
Consulting, Inc.

COVER PAGE

[illegible]

SHEET NUMBER

1.0



RESTORATION ALTERNATIVES

RESTORATION ALTERNATIVES FOR THE UPPER NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT AREA WERE DEVELOPED BY A MULTI-DISCIPLINARY TEAM CONSISTING OF RESOURCE PROFESSIONALS FROM TROUT UNLIMITED, THE US FOREST SERVICE, RIVER DESIGN GROUP, INC., GEUM ENVIRONMENTAL CONSULTING, INC. AND WESTWATER CONSULTANTS, INC. ALTERNATIVES RANGED FROM NO ACTION (ALTERNATIVE A) TO EXPANDING THE FLOODPLAIN AND CONVERTING THE EXISTING CHANNEL MORPHOLOGY TO MORE NATURAL STREAM TYPES AT THE APPROPRIATE ELEVATIONS (ALTERNATIVE E). A PREFERRED RESTORATION SCENARIO WAS DEVELOPED FOR THE PROJECT AREA BY ASSIGNING THE ALTERNATIVES TO EACH REACH OR SUB-REACH, BASED ON REACH-SPECIFIC LIMITING FACTORS, CONSTRAINTS, AND RESTORATION FEASIBILITY.

RESTORATION OBJECTIVES

THE REACH 2B AND REACH 2C DESIGN ADDRESSES REACH-SCALE LIMITING FACTORS AND CONSTRAINTS IDENTIFIED IN THE 2012 UPPER NINEMILE CREEK - HOUSUM PLACER RESTORATION PROJECT PHASE 2 ALTERNATIVES DEVELOPMENT REPORT (TROUT UNLIMITED, 2012). OBJECTIVES RELATED TO CHANNEL MORPHOLOGY, AQUATIC HABITAT, FLOODPLAIN RESOURCES, AND RIPARIAN VEGETATION CONDITIONS INCLUDE:

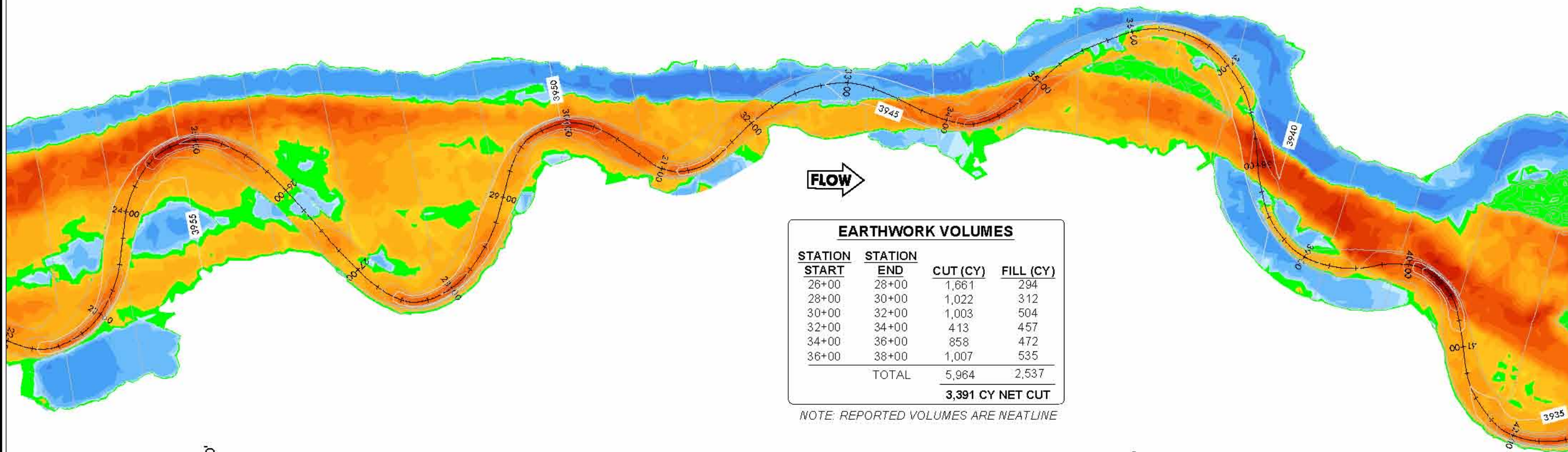
- PRODUCE CLEAN WATER CONSISTENT WITH SUPPORTING AQUATIC LIFE AND BENEFICIAL USES.
- CREATE COMPLEX AQUATIC HABITAT COMPONENTS SUCH AS DEPTH, VELOCITY, SUBSTRATE, COVER, AND POOLS THAT SUPPORT POPULATIONS OF WILD TROUT AND OTHER AQUATIC ORGANISMS.
- CONSTRUCT A STREAM CHANNEL THAT IS CONNECTED TO THE FLOODPLAIN AND INTERACTS WITH THE CHANNEL IN TERMS OF SURFACE FLOW AND SEDIMENT AND NUTRIENT EXCHANGE.
- MAXIMIZE RIPARIAN AND FLOODPLAIN HABITATS AND FUNCTIONS.
- INCORPORATE, TO THE GREATEST EXTENT FEASIBLE, HISTORICAL FLOODPLAIN AND TERRACE SURFACES.
- RECONNECT THE SAWPIT CREEK AND BEECHER CREEK CONFLUENCES TO IMPROVE FISH PASSAGE AND AQUATIC HABITAT CONDITIONS.
- REDUCE AVULSION RISK IN UPPER SAWPIT CREEK BY FILLING AN EXISTING DRAGLINE POND.

RESTORATION TREATMENTS

RESTORATION WORK WILL OCCUR ALONG 5,800 FEET OF CHANNEL (1.1 MILES) BEGINNING APPROXIMATELY 1,000 FEET UPSTREAM OF THE CONFLUENCE WITH BEECHER CREEK AND CONTINUING DOWNSTREAM TO THE START OF REACH 2D IN THE PROJECT AREA. RESTORATION WORK WILL BE COMPLETED OVER A TWO-YEAR PERIOD AND WILL BE CLOSELY INTEGRATED WITH PRIVATE LANDOWNERS, THE LOLO NATIONAL FOREST, TROUT UNLIMITED, AND PERMITTING AGENCIES INCLUDING THE MISSOULA CONSERVATION DISTRICT, MONTANA FISH, WILDLIFE & PARKS, MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY, AND THE U.S. ARMY CORPS OF ENGINEERS. THE EXISTING CHANNEL AND FLOODPLAIN MORPHOLOGY WILL BE MODIFIED TO INCLUDE RIFFLE AND POOL STREAM TYPES DEVELOPED WITHIN A BROAD, WELL VEGETATED RIPARIAN FLOODPLAIN CORRIDOR. IN LOCATIONS, THE CHANNEL BED WILL BE RAISED TO RECONNECT VEGETATED TERRACE SURFACES. A VARIETY OF STREAMBED, STREAMBANK, FLOODPLAIN, AND REVEGETATION TREATMENTS WILL BE IMPLEMENTED TO SUPPORT THE RESTORATION OBJECTIVES AND DESIRED OUTCOMES. TREATMENTS WILL BE NATIVE MATERIALS BASED AND DESIGNED TO MIMIC NATURALLY OCCURRING COMPONENTS OF A HEALTHY, FUNCTIONING STREAM CHANNEL AND FLOODPLAIN ECOSYSTEM. STREAMBED TREATMENTS WILL CONSIST OF COMPLEX AQUATIC HABITAT COMPONENTS INCLUDING, RIFFLE, RUN, POOL AND GLIDE FEATURES. STREAMBANK TREATMENTS WILL BE COMPOSED OF WOOD, ALLUVIUM, AND VEGETATION, AND WILL INCREASE BANK RESISTANCE TO EROSION. PROVIDING FOR SHORT-TERM STREAMBED AND STREAMBANK STABILITY IS REQUIRED TO SUPPORT THE VEGETATION DESIGN WHICH EMPHASIZES CREATING A SELF-SUSTAINING MOSAIC OF RIPARIAN AND WETLAND COMMUNITIES ON A FLOODPLAIN SURFACE THAT IS HYDROLOGICALLY CONNECTED TO THE CHANNEL. FLOODPLAIN TREATMENTS INCLUDE A VARIETY OF VEGETATION COVER TYPES THAT INTEGRATE PLANT SPECIES COMPOSITION WITH GEOMORPHOLOGY AND HYDROLOGY, AND ACCOUNT FOR ECOLOGICAL PROCESSES THAT SUPPORT PLANT COMMUNITY DEVELOPMENT OVER TIME. FLOODPLAIN TREATMENTS WILL INCLUDE THE USE OF SWALES, SIDE CHANNELS, OFF-CHANNEL WETLANDS, MICROTOPOGRAPHY, COARSE WOOD, PLANTINGS, AND SEEDING.

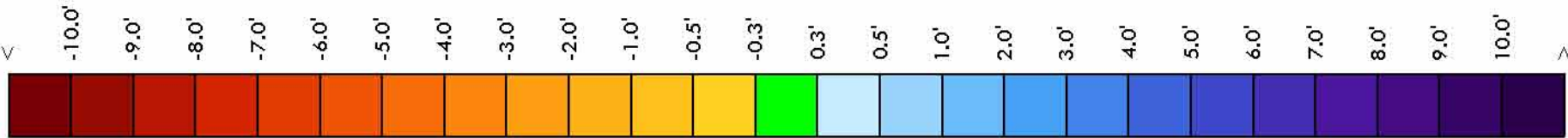
SITE PLAN

NO.	DATE	BY	DESCRIPTION	CHK
1	03-15-14	JL	FINAL DESIGN	JM
PROJECT NUMBER RDG-13-001				
SHEET NUMBER 3.0				



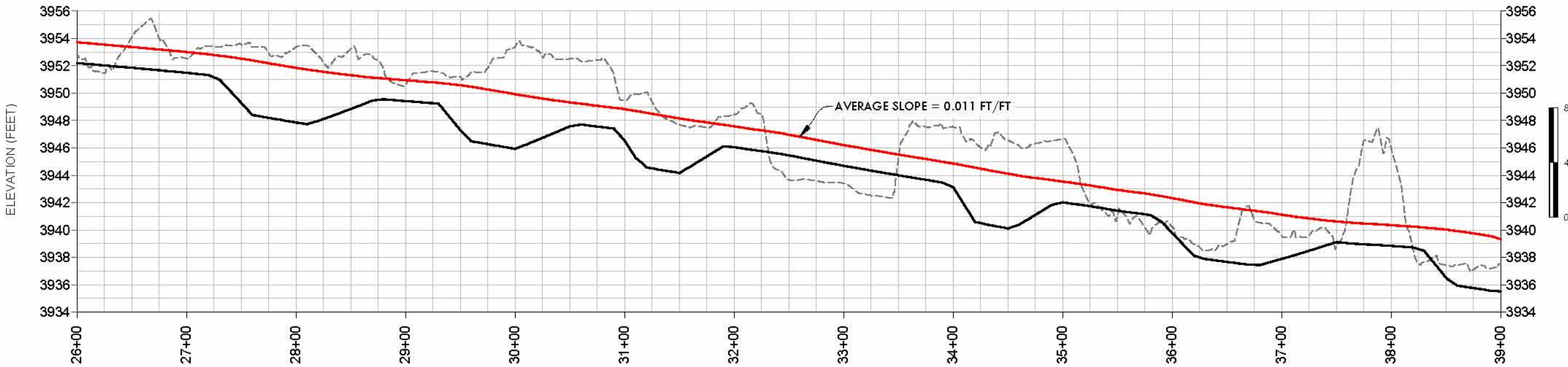
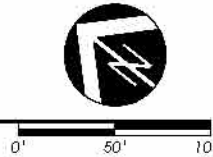
EARTHWORK VOLUMES			
STATION START	STATION END	CUT (CY)	FILL (CY)
26+00	28+00	1,661	294
28+00	30+00	1,022	312
30+00	32+00	1,003	504
32+00	34+00	413	457
34+00	36+00	858	472
36+00	38+00	1,007	535
TOTAL		5,964	2,537
		3,391 CY NET CUT	

NOTE: REPORTED VOLUMES ARE NEATLINE



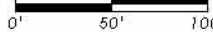
EXISTING GROUND COMPARED TO PROPOSED DESIGN SURFACE

PLAN VIEW
CONTOUR INTERVAL = 1 FOOT



LEGEND		
EXISTING GROUND	DESIGN BANKFULL	DESIGN THALWEG

PROFILE VIEW



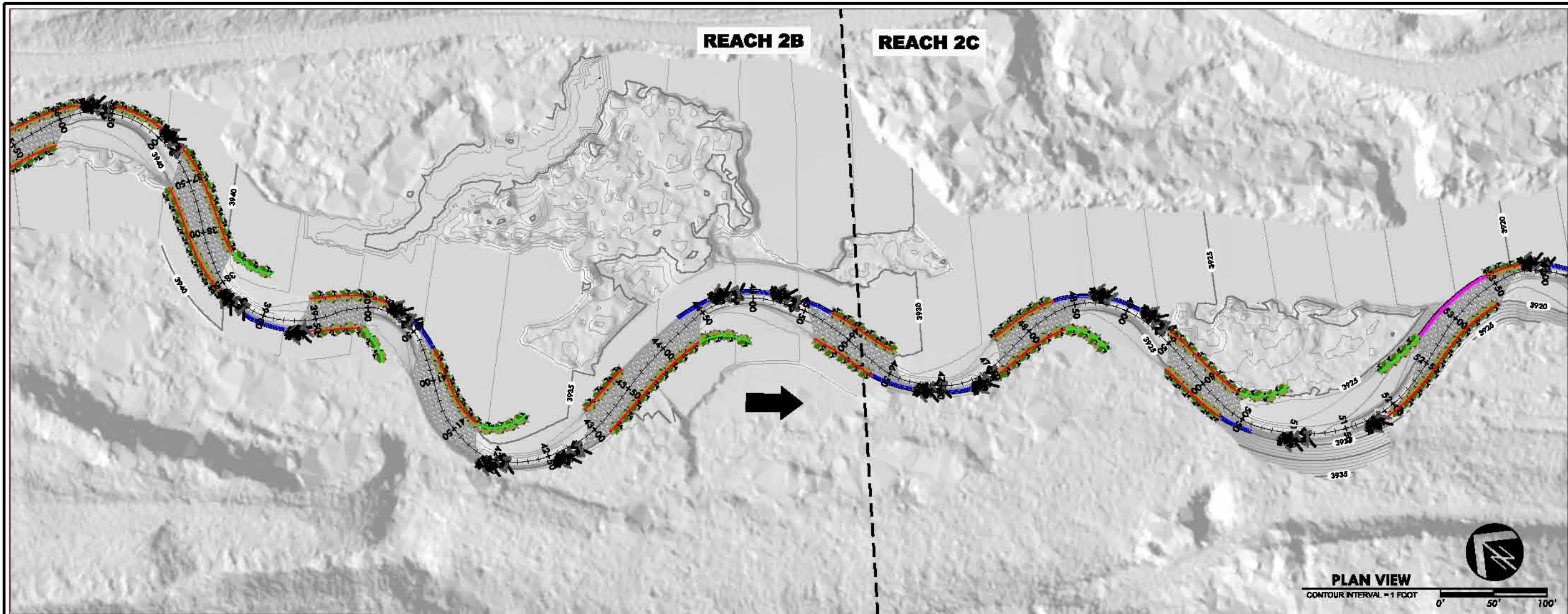
NO.	DATE	BY	DESCRIPTION	CHK
1	03-15-14	NW	FINAL DESIGN	MD

PROJECT NUMBER
RDG-13-001

SHEET NUMBER






5.5

**GRADING PLAN AND PROFILE
REACH 2B**



LEGEND

BANK STRUCTURES

	LARGE WOOD STRUCTURE TYPE (LWST 1)	8.0
	VEGETATED SOIL LIFT TYPE 1 (VSLT 1)	8.1
	VEGETATED SOIL LIFT TYPE 2 (VSLT 2)	8.2
	VEGETATED WOOD AND BRUSH FASCINE TYPE 1 (VWBF 1)	8.3
	VEGETATED WOOD AND BRUSH FASCINE TYPE 2 (VWBF 2)	8.3

CHANNEL STRUCTURES

	CONSTRUCTED RIFFLE (CR)	8.4
---	-------------------------	-----

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
39+00	3939.32
39+45	3938.53
40+00	3937.80
40+50	3937.13
41+00	3936.74
41+50	3936.40
42+00	3935.86
42+50	3935.15
43+00	3934.66
43+50	3934.31
44+00	3933.92
44+50	3933.41
45+00	3932.76
45+50	3931.86
46+00	3931.23
46+50	3930.59
47+00	3929.75
47+50	3928.91
48+00	3928.23
48+50	3927.40
49+00	3926.53
49+50	3925.90
50+00	3925.46
50+50	3924.87
51+00	3924.12
51+50	3923.25
52+00	3922.38

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
39+45	39+95	R	VWBF1	45+72	46+38	C	CR
39+47	40+15	L	VWBF1	45+72	46+38	L	VWBF1
39+49	39+93	C	CR	46+37	46+75	R	VSL2
39+95	40+50	R	VWBF2	46+75	47+05	R	LWS1
40+15	40+45	L	LWS1	47+05	47+25	R	VSL2
40+45	40+73	L	VSL2	47+25	47+50	R	LWS1
40+73	41+63	L	VWBF1	47+50	48+30	R	VWBF1
40+91	41+62	C	CR	47+70	48+30	L	VWBF1
41+63	42+45	L	VWBF2	47+73	48+33	C	CR
41+85	42+10	R	LWS1	48+30	49+00	R	VWBF2
42+55	42+80	R	LWS1	48+65	48+85	L	LWS1
43+05	43+60	L	VWBF1	48+85	49+10	L	VSL2
43+07	44+30	R	VWBF1	48+30	48+65	L	VSL2
43+08	44+29	C	CR	49+10	49+45	L	LWS1
44+28	44+60	L	VSL2	49+45	50+35	L	VWBF1
44+30	44+95	R	VWBF2	49+67	50+32	C	CR
44+60	44+90	L	LWS1	49+70	50+30	R	VWBF1
44+90	45+15	L	VSL2	49+90	50+15	R	LWS1
45+15	45+45	L	LWS1	50+30	50+60	R	VSL2
45+45	45+72	L	VSL2	50+35	50+85	L	VWBF2
45+70	46+37	R	VWBF1	51+65	51+80	R	LWS1
				51+90	53+40	R	VWBF1

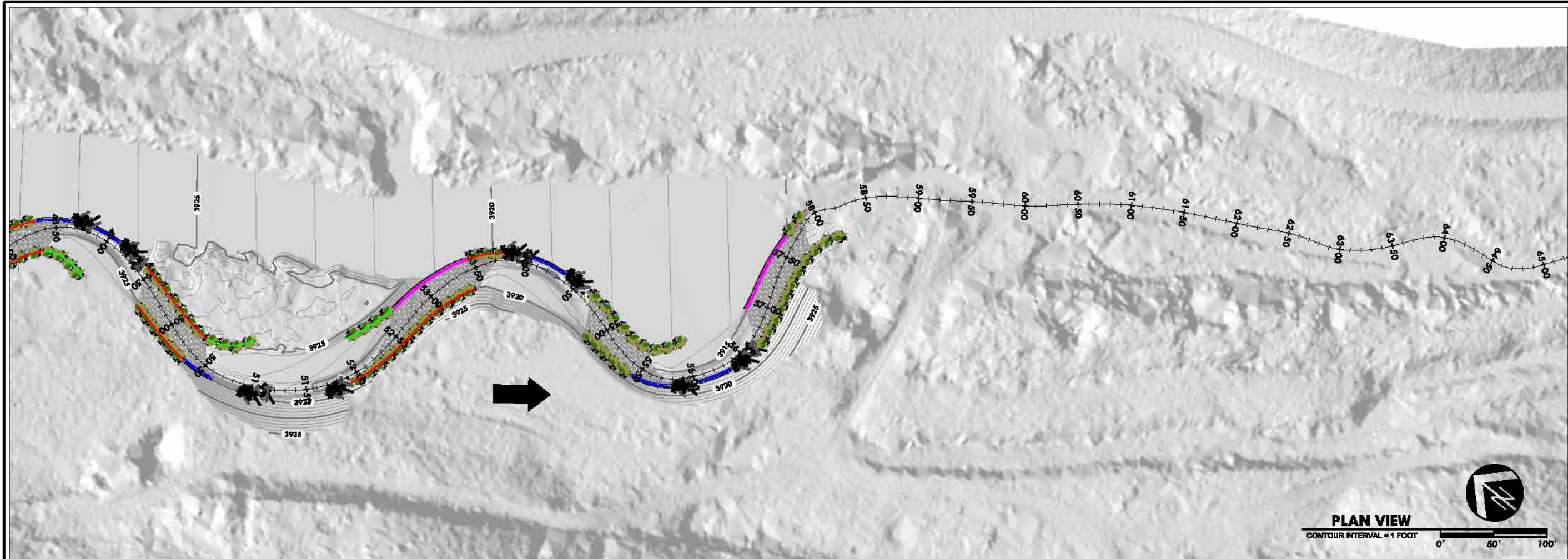
Structure Description

Large Wood Structure Type 1
Vegetated Soil Lift Type 1
Vegetated Soil Lift Type 2
Vegetated Wood and Brush Fascine Type 1
Vegetated Wood and Brush Fascine Type 2
Engineered Riffle

Abbreviation Drawing Sheet






LWS1	8.0
VSL1	8.1
VSL2	8.2
VWBF1	8.3
VWBF2	8.3
ER	8.4

NO.	DATE	BY	DESCRIPTION	CHK
1	03-15-14	NW	FINAL DESIGN	AD



LEGEND

BANK STRUCTURES

	LARGE WOOD STRUCTURE TYPE (LWST 1)	8.0
	VEGETATED SOIL LIFT TYPE 1 (VSLT 1)	8.1
	VEGETATED SOIL LIFT TYPE 2 (VSLT 2)	8.2
	VEGETATED WOOD AND BRUSH FASCINE TYPE 1 (VWBF 1)	8.3
	VEGETATED WOOD AND BRUSH FASCINE TYPE 2 (VWBF 2)	8.3

CHANNEL STRUCTURES

DETAIL SHEET

	CONSTRUCTED RIFFLE (CR)	8.4
---	-------------------------	-----

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
52+00	3922.38
52+50	3921.66
53+00	3921.06
53+50	3920.29
54+00	3919.42
54+50	3918.61
55+00	3918.08
55+50	3917.49
56+00	3916.64
56+50	3915.84
57+00	3915.35
57+50	3915.01
58+00	3914.53
58+50	3913.78
59+00	3913.04
59+50	3912.31
60+00	3911.63
60+50	3910.88
61+00	3910.23
61+50	3909.46
62+00	3908.76

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE
52+10	52+65	L	VWBF2
52+65	53+45	L	VSL1
52+68	53+45	C	CR
53+45	53+80	L	VWBF1
53+80	54+00	L	LWS1
54+00	54+35	L	VSL2
54+35	54+60	L	LWS1
54+60	55+45	L	VWBF1
54+89	55+45	C	CR
54+90	55+45	R	VWBF1
55+45	55+80	R	VSL2
55+80	56+00	L	VWBF2
56+00	56+00	R	LWS1
56+00	56+35	R	VSL2
56+35	56+65	R	LWS1
56+65	57+70	R	VWBF1
56+90	57+85	L	VSL1
56+91	57+87	C	CR
57+67	57+95	L	VWBF1
57+95	58+20	R	VWBF2

Structure Description

Large Wood Structure Type 1
Vegetated Soil Lift Type 1
Vegetated Soil Lift Type 2
Vegetated Wood and Brush Fascine Type 1
Vegetated Wood and Brush Fascine Type 2
Engineered Riffle

Abbreviation

LWS1
VSL1
VSL2
VWBF1
VWBF2
ER

Drawing Sheet

8.0
8.1
8.2
8.3
8.3
8.4



3098 Hwy 93 South
Whitfield, VT 05993
Tel: 802-462-6927
Fax: 802-462-4985

311 SW Jefferson Avenue
Corvallis, OR 97333
Tel: 541-754-2920
Fax: 541-754-2924

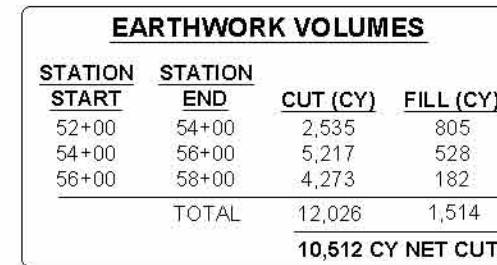
PLAN VIEW AND STRUCTURE LAYOUT REACH 2C

NO.	DATE	BY	DESCRIPTION	CHK
1	03-15-14	NW	FINAL DESIGN	AD

PROJECT NUMBER
RDG-13-001

SHEET NUMBER

5.8



LEGEND

---	EXISTING GROUND
---	DESIGN BANKFULL
---	DESIGN THALWEG

0' 50' 100'

GRADING PLAN AND PROFILE REACH 2C

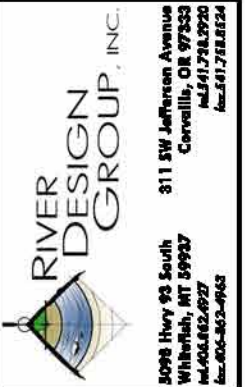
[illegible]

PROJECT NUMBER
RDG-13-001

SHEET NUMBER

5.9

BANKFULL CHANNEL DESIGN CRITERIA				
STREAM TYPE		C4 -> B4c		
DISCHARGE		140 CFS		
VALLEY SLOPE		0.0148 FT/FT		
SINUOSITY		1.35		
CHANNEL SLOPE		0.0110 FT/FT		
PARAMETER FEATURE	RIFFLE	RUN	POOL	GLIDE
WIDTH	27.5-33.6 ft	27.5-36.6 ft	36.8-42.7 ft	33.6-39.7 ft
MEAN DEPTH	1.3-1.5 ft	1.1-1.8 ft	1.4-1.6 ft	1.1-1.8 ft
MAX. DEPTH	1.5-2.0 ft	1.8-2.5 ft	3.2-4.4 ft	1.6-2.8 ft
XS AREA	38.5 sq ft	42.4 sq ft	53.9 sq ft	46.2 sq ft
WIDTH:DEPTH	20-24	N/A	N/A	N/A

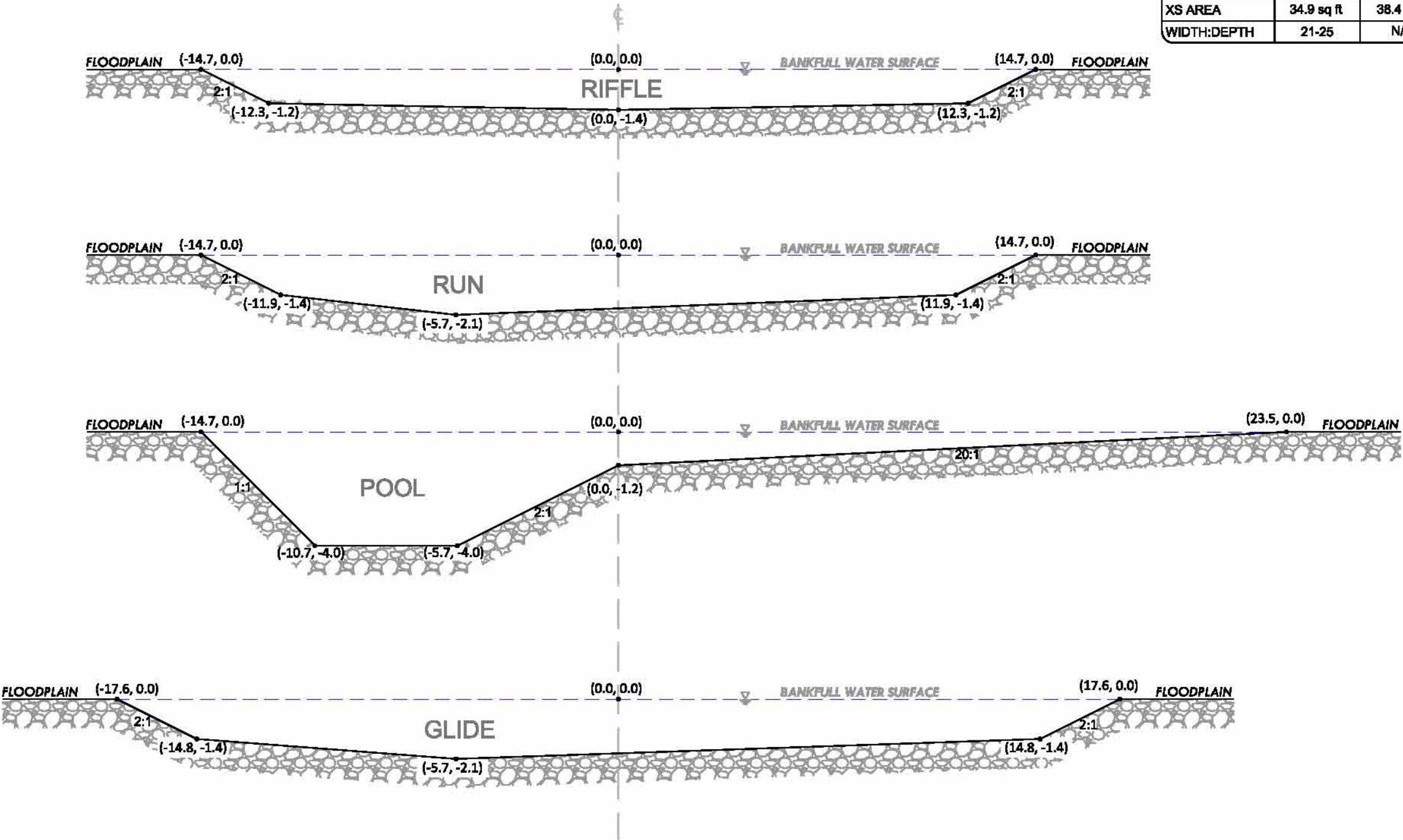


**CHANNEL CROSS
SECTION DIMENSIONS
REACH 2C - 1**

[illegible]

STATION 45+72 TO 57+93

BANKFULL CHANNEL DESIGN CRITERIA				
STREAM TYPE		B4		
DISCHARGE		140 CFS		
VALLEY SLOPE		0.0181 FT/FT		
SINUOSITY		1.35		
CHANNEL SLOPE		0.0151 FT/FT		
PARAMETER FEATURE	RIFFLE	RUN	POOL	GLIDE
WIDTH	28.4-32.2 ft	26.4-35.2 ft	35.2-41.0 ft	32.2-38.1 ft
MEAN DEPTH	1.2-1.4 ft	1.1-1.7 ft	1.3-1.5 ft	1.1-1.7 ft
MAX. DEPTH	1.4-1.9 ft	1.7-2.4 ft	3.0-4.2 ft	1.5-2.6 ft
XS AREA	34.9 sq ft	38.4 sq ft	48.9 sq ft	41.9 sq ft
WIDTH:DEPTH	21-25	N/A	N/A	N/A



CHANNEL CROSS SECTIONS
TYPICAL



NOTE: COORDINATES ARE REFERENCED FROM TOP OF BANK CENTERLINE

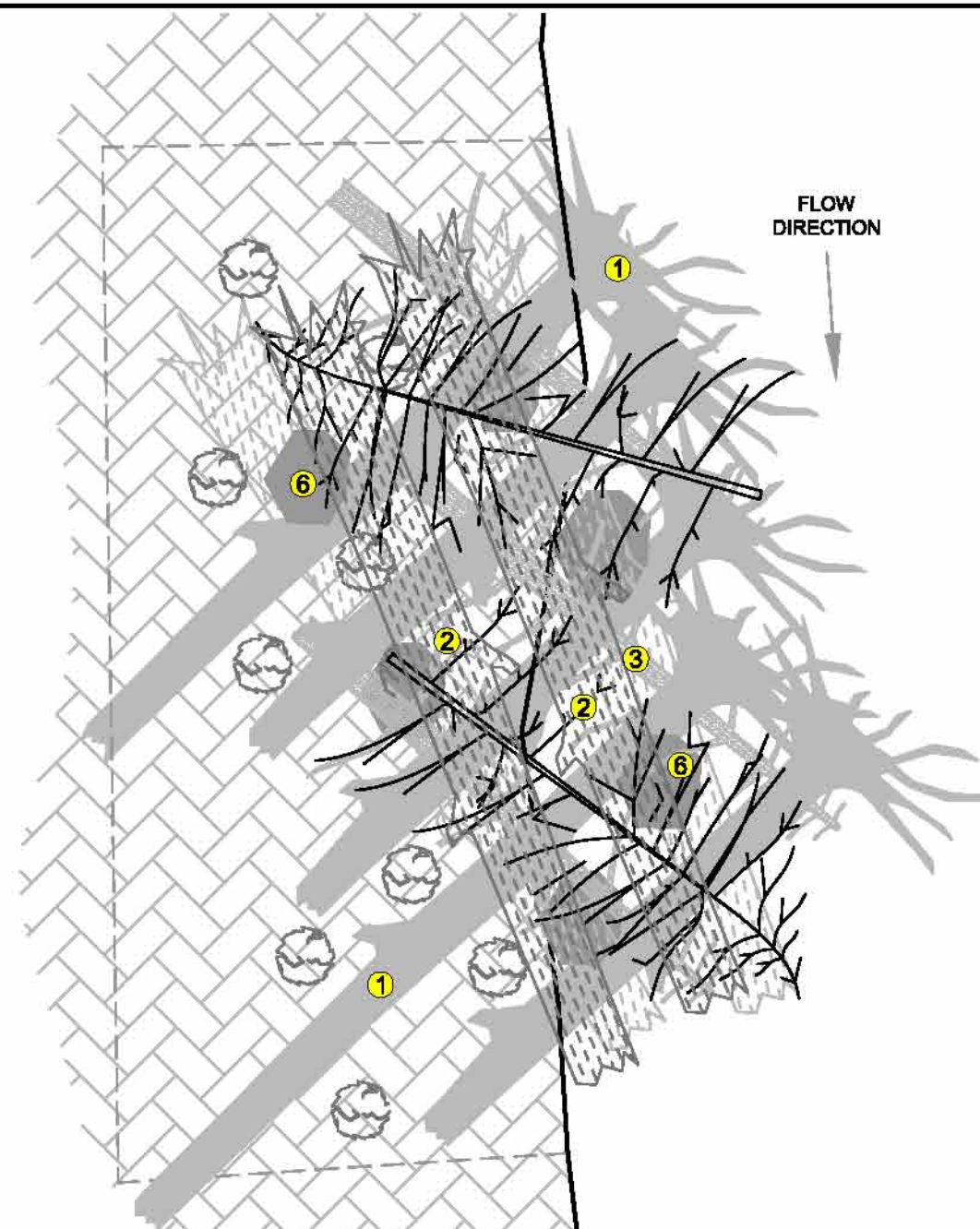


311 SW Jefferson Avenue
Corvallis, OR 97333
TEL: 541.758.8720
FAX: 541.758.8724

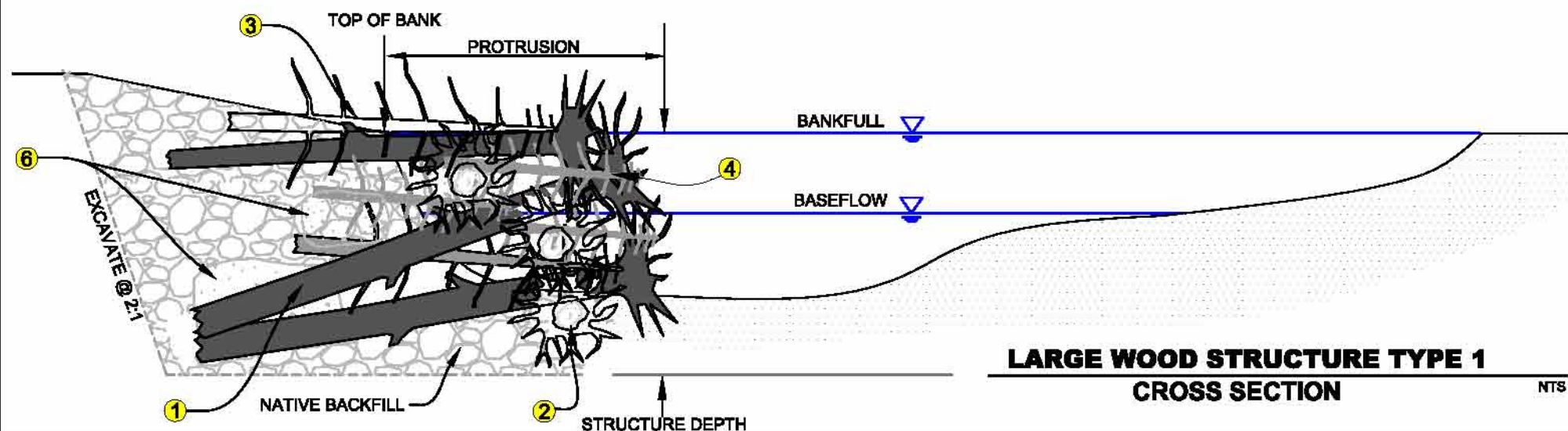
2098 Hwy 93 South
Whitefish, MT 59937
TEL: 406.662.6727
FAX: 406.662.4955

CHANNEL CROSS
SECTION DIMENSIONS
REACH 2C - 2

NO.	DATE	BY	DESCRIPTION	CHK
1	03-15-14	JL	FINAL DESIGN	JM
PROJECT NUMBER				
RDG-13-001				
SHEET NUMBER				
7.4				



LARGE WOOD STRUCTURE TYPE 1
PLAN VIEW NTS



LARGE WOOD STRUCTURE TYPE 1
CROSS SECTION NTS

DESIGN INTENT

THE INTENT OF THE LARGE WOOD STRUCTURE IS TO PROVIDE SHORT-TERM STREAMBANK PROTECTION AND STABILIZATION BY RE-DIRECTING FLOW AWAY FROM THE CHANNEL MARGINS, DISSIPATING ENERGY, REDUCING NEAR-BANK STRESS, AND MAINTAINING LATERAL SCOUR POOLS. THE STRUCTURE ALSO PROVIDES BANK STRENGTH TO SUPPORT RIPARIAN VEGETATION ESTABLISHMENT ALONG OUTSIDE MEANDER STREAMBANKS. THE STRUCTURE INCORPORATES SEVERAL TIERS OF BRUSH AND WOOD TO INCREASE CHANNEL MARGIN ROUGHNESS AND PROVIDE NEAR-BANK AQUATIC HABITAT COMPLEXITY. THE STRUCTURE INCLUDES A CONSTRUCTED TOE TO PROVIDE STREAMBANK STABILITY FOR DESIGN EVENT NEAR-BANK SHEAR STRESS CONDITIONS. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT.

THE LARGE WOOD STRUCTURE IS USED IN AREAS OF HIGH SHEAR STRESS ALONG THE CHANNEL PLANFORM, SPECIFICALLY OUTSIDE MEANDER STREAMBANKS ALONG POOL AND RUN CHANNEL UNITS. OVER TIME, THE STRUCTURE WILL ACCUMULATE ADDITIONAL COARSE WOOD AND DEFORM AS THE CHANNEL MIGRATES ACROSS THE FLOODPLAIN.

CONSTRUCTION NOTES

EXCAVATE TRENCH AND SET FOOTER LOGS AT SPECIFIED DEPTH. USE FOOTER LOGS WITH MINIMUM DIAMETER AND STEM LENGTH AS SPECIFIED. FOOTER LOGS SHALL NOT HAVE A ROOTFAN. IF POSSIBLE, BACKFILL UP TO TOP OF FOOTER LOGS WITH SPECIFIED ALLUVIAL BACKFILL. DOUSE BACKFILL PERIODICALLY WITH WATER TO IMPROVE COMPACTION AND MINIMIZE VOID SPACES.

SET ROOTWAD LOGS ON FOOTER LOGS. PLACE LOGS STEMS SLOPING DOWNWARD INTO BANK FROM EDGE OF WATER. USE ROOTWADS WITH MINIMUM ROOTFAN DIAMETER AND STEM LENGTH AS SPECIFIED. BACKFILL UP TO TOP OF ROOTWAD LOGS AND PLACE BALLAST ROCKS ON TOP OF ROOTWAD LOGS AT LOCATIONS WHERE ROOTWAD LOGS INTERSECT FOOTER LOGS. DOUSE BACKFILL PERIODICALLY WITH WATER TO IMPROVE COMPACTION AND MINIMIZE VOID SPACES.

ADD ADDITIONAL TIER OF FOOTER LOGS AND ROOTWAD LOGS AS SHOWN AND DESCRIBED ABOVE. COVER BALLAST ROCKS AND TOP OF STRUCTURE WITH ALLUVIUM AS APPROVED BY THE CONSTRUCTION MANAGER. PLACE DEFLECTOR LOGS AND BRUSH ON TOP TIERS AS SHOWN.

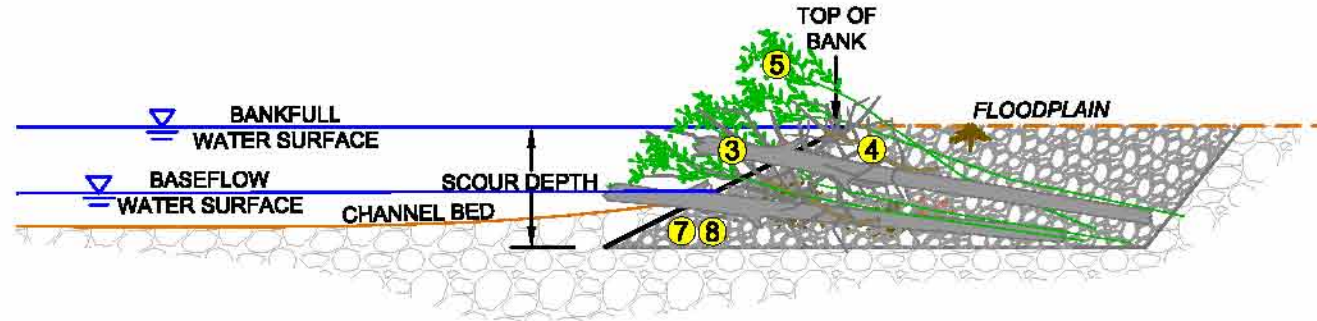
THE CONSTRUCTION MANAGER SHALL INSPECT AND APPROVE ALL FOOTER LOGS AND ROOTWAD LOGS PRIOR TO BACKFILLING. NOTIFY CONSTRUCTION MANAGER OF ANY PROPOSED CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER RESERVES THE RIGHT TO MODIFY STRUCTURE DESIGN SPECIFICATIONS DURING CONSTRUCTION IF WARRANTED DUE TO UNFORESEEN CONDITIONS.

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM		DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
1	CATEGORY 1 WOOD	18-24	30	YES	NO	8
2	CATEGORY 2 WOOD	12-18	18-20	YES	NO	
3	CATEGORY 3 WOOD	6-12	10-12	OPTIONAL	YES	10
4	CATEGORY 4 WOOD	6-MINUS	8-12	OPTIONAL	YES	15
6	CATEGORY 1 ROCK	12-24				10

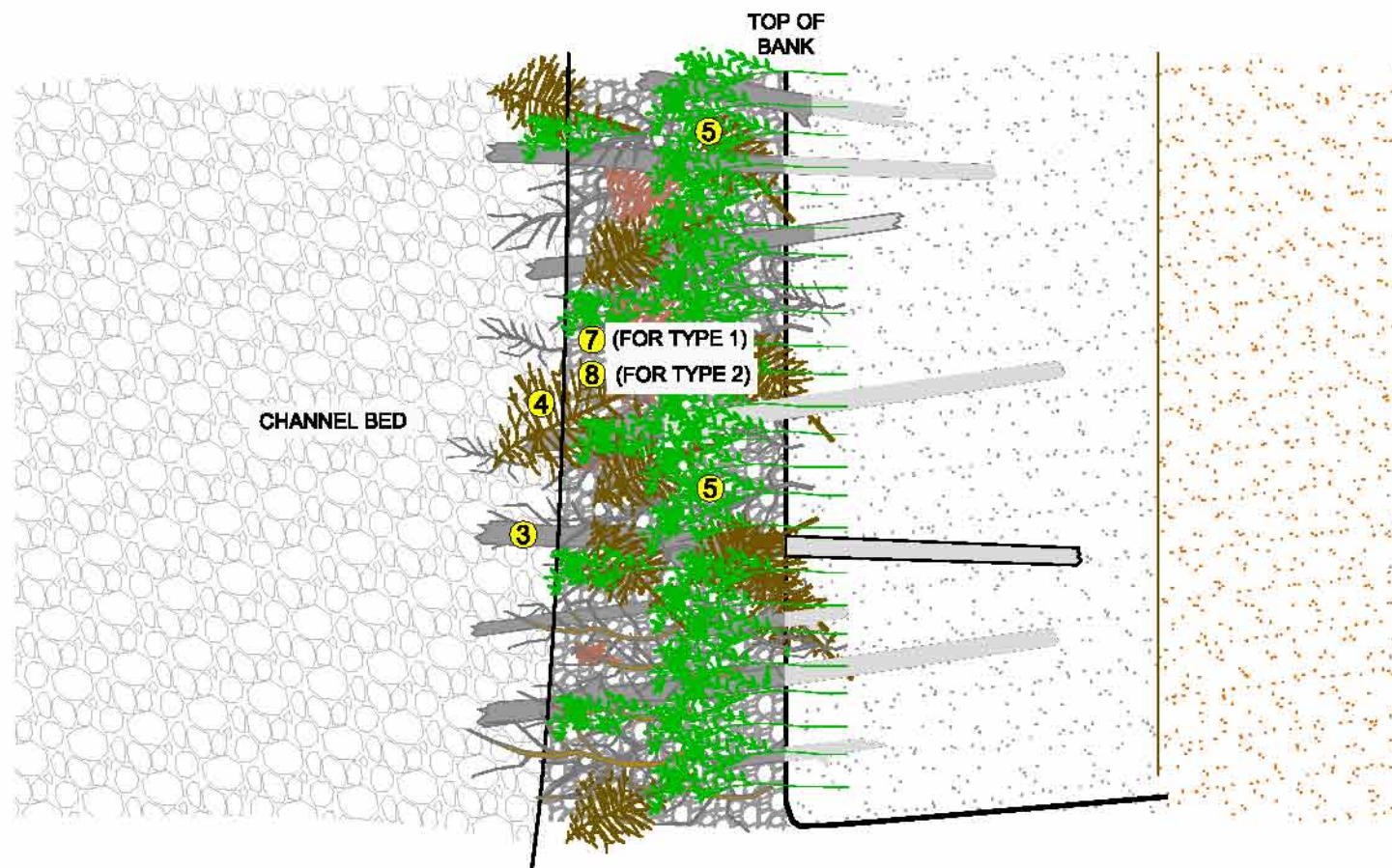


EXAMPLE OF A LARGE WOOD STRUCTURE



7 (FOR TYPE 1)
8 (FOR TYPE 2)

VEGETATED WOOD AND BRUSH FASCINE TYPE 1
SECTION VIEW NTS



VEGETATED WOOD AND BRUSH FASCINE TYPE 1
PLAN VIEW NTS

DESIGN INTENT

THE INTENT OF THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE IS TO PROVIDE SITE CONDITIONS DIRECTLY ALONG THE CHANNEL BOUNDARIES (STREAMBANKS) THAT ARE SUITABLE FOR GROWING RIPARIAN VEGETATION. THE VEGETATED WOOD AND BRUSH FASCINE STRUCTURE PROVIDES BANK STRENGTH IN THE SHORT-TERM UNTIL MATURE RIPARIAN VEGETATION ESTABLISHES AND PROVIDES LONG-TERM STREAMBANK STABILITY. THE STRUCTURE ALSO PROVIDES CHANNEL MARGIN ROUGHNESS AND NEAR-BANK AQUATIC HABITAT COMPLEXITY.

THE TYPE 1 STRUCTURE IS USED IN ZONES OF HIGH SHEAR STRESS ALONG THE CHANNEL PLANFORM INCLUDING OUTSIDE MEANDER STREAMBANKS, RIFFLE CHANNEL UNITS, AND RUN AND GLIDE CHANNEL UNIT TRANSITIONS. THE STRUCTURE IS USED IN A SEQUENCE WITH OTHER STREAMBANK STABILIZATION STRUCTURES AND IS NOT USED AS A STAND-ALONE TREATMENT. THE TYPE 1 STRUCTURE INCLUDES A CONSTRUCTED TOE TO PROVIDE STREAMBANK STABILITY FOR DESIGN EVENT NEAR-BANK SHEAR STRESS CONDITIONS.

THE TYPE 2 STRUCTURE PROVIDES SIMILAR FUNCTION TO THE TYPE 1 STRUCTURE BUT IS USED IN ZONES OF LOW SHEAR STRESS, OR PASSIVE MARGINS. THE TYPE 2 STRUCTURE DOES NOT INCLUDE A CONSTRUCTED TOE AND IS TYPICALLY PLACED ALONG INSIDE MEANDER STREAMBANKS (E.G. POINT BARS AND MEANDER CORES) TO INCREASE CHANNEL BOUNDARY ROUGHNESS AND SUPPORT RIPARIAN VEGETATION ESTABLISHMENT.

CONSTRUCTION NOTES

VEGETATED WOOD AND BRUSH FASCINE TYPE 1 SHALL BE BUILT ON IMPORTED ALLUVIUM AS SPECIFIED. VEGETATED WOOD AND BRUSH FASCINE TYPE 2 SHALL BE BUILT ON SUITABLE NATIVE ALLUVIUM AS SPECIFIED. THE CONSTRUCTION MANAGER SHALL VIEW AND APPROVE FOUNDATION LAYER. BRUSH TOE SHALL BE PLACED IN CONJUNCTION WITH NATIVE ROCK AND LAYERED TO AT A 1:1 SLOPE TO CREATE THE TOE OF THE STRUCTURE. MATERIAL AND SHALL BE STABILIZED DOWN TO THE MAXIMUM ANTICIPATED RUN SCOUR DEPTH.

INTERLACE LIVE CUTTINGS WITH BRUSH, WOOD AND NATIVE ALLUVIUM TO CREATE THE DESIGN BANK. CUTTINGS SHALL BE A MIN. LENGTH OF 8' AND MIN. WIDTH OF 0.25' WITH A MAXIMUM OF 2' FEET EXPOSED. INSTALL WHILE VEGETATION IS DORMANT.

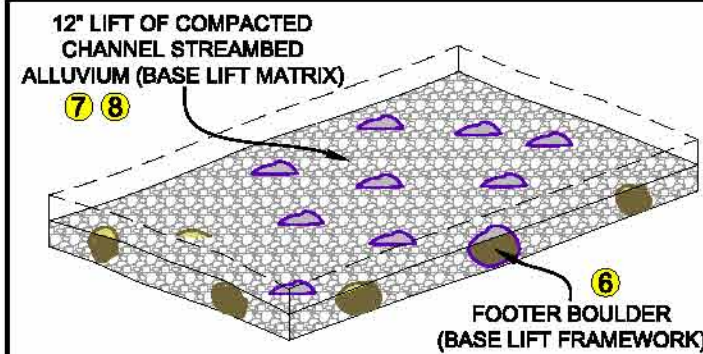
NOTIFY CONSTRUCTION MANAGER OF ANY PROPOSED CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER RESERVES THE RIGHT TO MODIFY STRUCTURE DESIGN SPECIFICATIONS DURING CONSTRUCTION IF WARRANTED DUE TO UNFORESEEN CONDITIONS.

MATERIAL SCHEDULE (PER LINEAR FOOT)

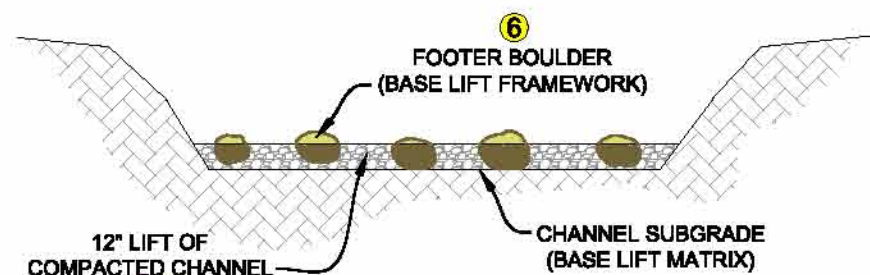
ITEM	DIAMETER (IN)	LENGTH (FT)	ROOTWAD	LIMBS	QUANTITY
3 CATEGORY 3 WOOD	6-12	10-12	OPTIONAL	YES	2
4 CATEGORY 4 WOOD	8-MINUS	8-12	OPTIONAL	YES	3
5 RIPARIAN CUTTINGS	0.25	8-8		YES	10
7 CATEGORY 2 ROCK	6-PLUS				0.25
8 CATEGORY 3 ROCK	6-MINUS				0.25



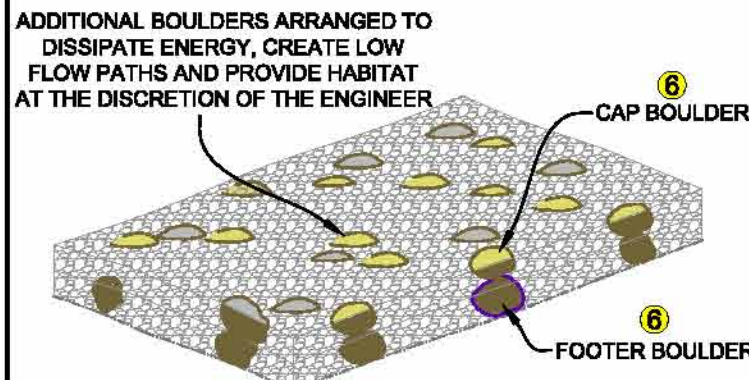
EXAMPLE OF A CONSTRUCTED VEGETATED WOOD AND BRUSH FASCINE



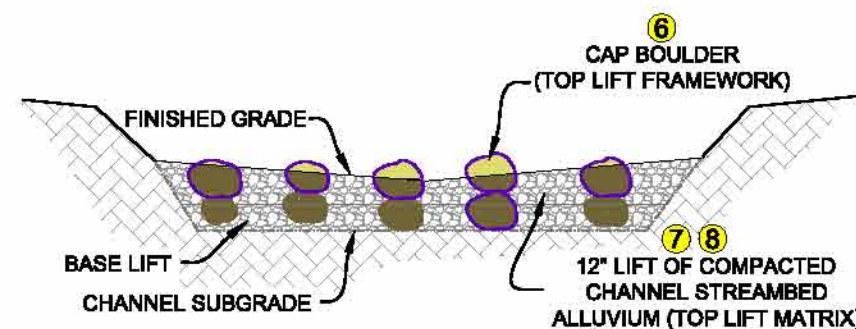
BASE LIFT INSTALLATION
3-D VIEW NTS



BASE LIFT INSTALLATION
SECTION VIEW NTS



TOP LIFT INSTALLATION
3-D VIEW NTS



TOP LIFT INSTALLATION
SECTION VIEW NTS

DESIGN INTENT

THE INTENT OF THE CONSTRUCTED RIFFLE IS TO PROVIDE A STABLE CONSTRUCTED SURFACE COMPRISED OF NATIVE AND IMPORTED (WHEN NECESSARY) SUBSTRATE. THE ENGINEERED FILL IS USED TO INCREASE THE RIVER CHANNEL BED ELEVATION AND IS TYPICALLY CONSTRUCTED TO FORM RIFFLE, RUN, AND GLIDE HABITAT UNITS. THE FILL COMPOSITION INCLUDES THREE PRIMARY SUBSTRATE CLASSIFICATIONS INCLUDING GRAVELS, COBBLES, BOULDERS, AND FINES. GRAVELS AND COBBLES FORM THE ENGINEERED FILL MATRIX. BOULDERS PROVIDE SCOUR RESISTANCE, INFLUENCE LOW FLOW STREAM FLOW PATTERNS AND HYDRAULICS, AND CREATE HABITAT. FINES ARE WASHED INTO THE MATRIX MATERIAL TO SEAL THE STREAMBED TO REDUCE PERCOLATION LOSSES AND BED MATERIAL MOVEMENT. BOULDERS PROTRUDE FROM THE ENGINEERED FILL SURFACE TO PROMOTE DIVERSE FLOW PATHS, PROVIDE ENERGY DISSIPATION, AND CREATE AQUATIC HABITAT.

CONSTRUCTION NOTES

1. CONTRACTOR TO STOCKPILE ENGINEERED FILL MATERIAL PER DESIGN SPECIFICATIONS. MATERIALS ARE TO BE STOCKPILED IN THE IMMEDIATE PROJECT AREA.
2. TREAT EXISTING CHANNEL BED BY REMOVING ORGANICS AND CREATING A PRISMATIC WORKING SURFACE. ALL LARGE COBBLE AND BOULDERS SHALL BE SALVAGED AND STOCKPILED.
3. PREPARE THE BASE LIFT FRAMEWORK. CONTRACTOR SHALL PLACE CATEGORY 1 ROCK (FOOTER BOULDERS) ON THE SURFACE OF THE CHANNEL SUBGRADE AS INDICATED ON THE DRAWING.
4. PREPARE THE BASE LIFT MATRIX. AFTER THE BASE LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE A MIXTURE OF CATEGORY 1 AND CATEGORY 2 ROCK (BASE LIFT MATRIX) IN BASE LIFT AND WASH FINES INTO STREAMBED TO CREATE A MATRIX SURROUNDING BASE LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.
5. PREPARE THE TOP LIFT FRAMEWORK. CONTRACTOR SHALL PLACE CATEGORY 1 ROCK (CAP BOULDERS) IN CONTACT WITH THE FOOTER BOULDERS. CAP ROCKS SHALL BE SET AND ORIENTED 0.5-FT. UPSTREAM OF THE FOOTER ROCK WITH NO LESS THAN 50% OF THE CAP BOULDER SURFACE AREA IN CONTACT WITH THE FOOTER BOULDER. DUE TO THE INHERENT VARIABILITY IN MATERIALS, CAP ROCK ELEVATIONS SHALL BE ADJUSTED TO ASSURE BOULDER PROTRUSION ABOVE FINISH GRADE IS NO GREATER THAN 1.0-FT.
6. PREPARE THE TOP LIFT MATRIX. AFTER THE TOP LIFT FRAMEWORK IS PREPARED AND INSPECTED BY ENGINEER, PLACE A MIXTURE OF CATEGORY 1 AND CATEGORY 2 ROCK (TOP LIFT MATRIX) IN TOP LIFT AND WASH FINES INTO STREAMBED TO CREATE A MATRIX SURROUNDING TOP LIFT FRAMEWORK. CHANNEL ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS IN LIFTS OF 12-INCHES TO FINISHED GRADE. INDIVIDUAL COURSES SHALL BE BUCKET COMPACTED.

MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	DIAMETER (IN)	QUANTITY
6	CATEGORY 1 ROCK	12-24	0.6 EA
7	CATEGORY 2 ROCK	8-PLUS	1.0 CY
8	CATEGORY 3 ROCK	8-MINUS	0.5 CY

NOTE: PRIOR TO INSTALLATION ALL LARGE COBBLE AND BOULDERS SHALL BE SALVAGED FROM EXISTING CHANNEL.



CHANNEL SUBGRADE



TOP LIFT MATRIX



BASE LIFT MATRIX



TOP LIFT MATRIX WITH FRAMEWORK



TYPICAL CONSTRUCTED RIFFLE



TYPICAL CONSTRUCTED RIFFLE

NO.	DATE	BY	DESCRIPTION	CHK
1	3-15-14	NW	FINAL DESIGN	JM
2	04-10-14	NW	REVISION	JM

PROJECT NUMBER
RDG-13-010

SHEET NUMBER

8.4